(12) UK Patent Application (19) GB (11) 2 077 618 A

(21) Application No 8019367
(22) Date of filing
13 Jun 1980
(43) Application published
23 Dec 1981
(51) INT CL³ B01F 7/10
B01D 11/02
(52) Domestic classification
B1Q 1
(56) Documents cited
None
(58) Field of search
B1Q
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(54) Contactor

(57) A slurry/liquid contactor has a stationary drum (12) through which the phases pass; and a rotor (14) within the drum comprising a number of axially-spaced discs (16), which divide the drum interior into a series of compartments and which have edges displaced from the drum wall, and a number of buckets (20) carried in each of a succession of the compartments between successive discs (16). The buckets (20) in each compartment are angularly displaced relative to those of adjacent compartments so that the corresponding buckets (20) in successive compartments are helically arranged about the rotor axis (15). The buckets 20, if they have toothed edges as shown, may extend beyond the periphery of discs 16. If the bucket edges are straight, they lie within the confines of discs 16 to minimize pick-up of undesired solid from the drum bottom.

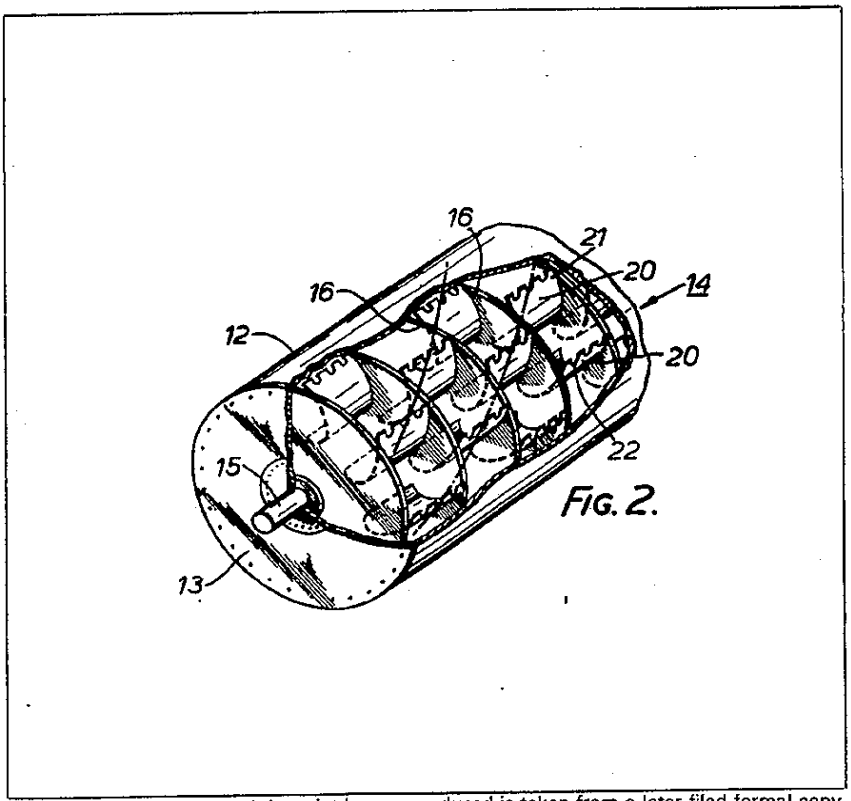

FIG. 2.

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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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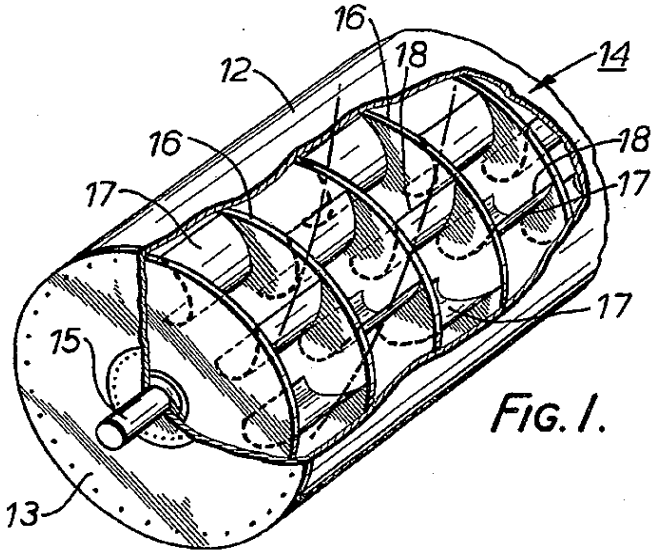

FIG. 1.

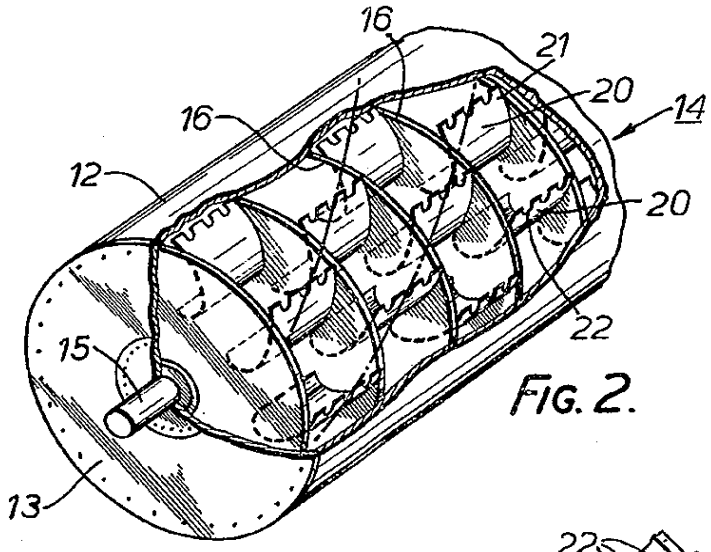

FIG. 2.

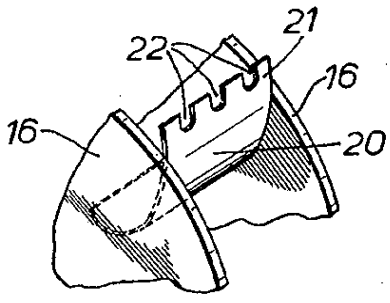

FIG. 3.

SPECIFICATION

Contactor

This invention relates to apparatus for contacting materials and is particularly concerned with a slurry/liquid contactor, in which the slurry is either introduced into the contactor or in which a solids phase and a carrier liquid are separately introduced and a slurry is formed within the contactor. In the contactor, the slurry is brought intimately and continually into contact with a treatment liquid phase, which is substantially immiscible with the carrier liquid or the liquid of the slurry and which has a lower specific gravity than that latter liquid. A contactor of the invention may be applied to the treatment of oil-sands with hot water or with a solvent for the bitumen oil constituents of the oil-sands, in order to extract the bitumen oils, as described for example in UK patent specification No. 1527269.

In US patent specification No. 3649209 there is described a solids-liquid contactor comprising a drum through which the phases can pass, preferably in counter-current, a rotor within the drum including a plurality of axially-spaced discs dividing the drum interior into a series of compartments, the edges of the discs being spaced from the wall of the drum to form an annular passage for the movement of the phases from compartment to compartment, and, for each of at least some of the compartments, a plurality of receptacles mounted to rotate with the rotor and designed to receive material of one phase and to discharge it into the other phase as the rotor turns. When a slurry is treated in such a contactor, the slurry and the treatment liquid phases travel through the contactor with a substantially stable interface between the treatment liquid phase and the liquid of the slurry, that interface usually being arranged to pass through the drum axis. The invention is generally concerned with such a contactor.

Because, in the contactor of US patent specification No. 3649209, the receptacles are carried within the peripheries of the discs, there is a serious possibility of the solids of the slurry settling to the bottom of the stationary drum and forming a stationary, and often compacted, layer of solids occupying the annular space between the discs and the drum over a substantial sector at the lower part of the drum. That layer, if allowed to remain, obstructs the movement of the slurry through the drum and prevents the proper operation of the contactor. In particular, the presence of a stationary layer of solids increases the pressure drop along the drum and may necessitate the tilting of the axes of the drum and rotor away from the horizontal, in order to maintain the interface between the treatment phase and the liquid of the slurry approximately at the drum axis.

In our British Patent Application No. 42461/78 published under Serial No. 2009614 we have described the use of a blade or blades carried by the rotor and projecting outwardly beyond the edges of the discs towards the drum wall. As the rotor turns, the blade acts to keep the solids in suspension so that they may be moved axially along the contactor with the carrier liquid. According to the application, the blade or each blade may be helical about the rotor axis in order directly to promote axial movement of the solids.

If the blades of application No. 42461/78 are integral with, or continuations of, the leading edges of the buckets, there is the possibility that solids scooped up by the blades will be directed into the buckets, carried up by them and released in each compartment, to the detriment of the process being performed in the contactor.

In one aspect of the present invention, we dispense with the use of a blade or blades penetrating the drum-discs space and, instead, arrange the corresponding receptacles in successive compartments in a helix about the rotor axis. Thus, according to that aspect of the invention, a contactor comprises a drum through which the phases to be contacted pass; a rotor within the drum including a plurality of axially-spaced discs which divide the drum interior into a series of compartments and which have no central openings, the edges of the discs being spaced from the wall of the drum to form annular passages for the movement of the phases from compartment to compartment; and a plurality of receptacles mounted to rotate with the rotor and designed to receive material of each phase and to shower it into the other phase as the rotor turns, the corresponding receptacles in successive compartments being arranged helically about the rotor axis.

The receptacles may be arranged with their leading edges parallel to the axis of the rotor, in which case corresponding receptacles in successive compartments are displaced angularly from one another. Alternatively the leading edge of each bucket may be formed as part of a helix, so that the leading edges of receptacles in successive compartments from a continuous or near-continuous helix. In either case, no impelling blade entering the drum-discs space is carried by the rotor, contrary to the disclosure of the above patent application, the helical disposition of the buckets themselves resulting in a screwing action on the liquid in the annular space between the drum and the discs and thus promoting movement of the solids.

The receptacles are preferably similar to those described in the above patent application, i.e. their leading edges are disposed close to the cylinder on which the disc edges lie and the receptacles are secured between

successive discs.

In some applications, it is undesirable that the solids at the bottom of the drum should be carried up and released in each compartment. To avoid that occurrence, each of at least some of the buckets preferably has one or more slots in it, opening to the leading edge of the bucket, Then, any solids captured by the leading edge of a bucket at the bottom of the drum fall through the slot or slots as the rotor turns and before those solids are lifted to any extent.

Provided that the above mentioned slots are present, the leading edges of the helically arranged buckets may be extended beyond the edges of the discs and into the drum-discs annular space, since the presence of the slots minimises the amount of solids carried up and released by the buckets. Thus, a second aspect of the invention resides in a contactor comprsing a drum through which the phases to be contacted pass; a rotor within the drum including a plurality of axially-spaced discs which divide the drum interior into a series of compartments and which have no central openings, the edges of the discs being spaced from the wall of the drum to form annular passages for the movement of the phases from compartment to compartment; and a plurality of receptacles mounted to rotate with the rotor and designed to receive material of each phase and to shower it into the other phase as the rotor turns, each receptacle having a leading edge which extends into the drum-disc space and which has at least one slot cut into it to reduce the amount of solids raised by the leading edge.

The invention will be more readily understood by way of example from the following description of contactors in accordance therewith, reference being made to the accompanying drawing, in which

Figure 1 is a part cut-away perspective view of a contactor having buckets which do not extend into the drum-rotor space.

Figure 2 is a similar view of contactor having buckets the leading edges of which project into the drum-rotor space, and

Figure 3 is a perspective view of a bucket of Fig. 2 on enlarged scale.

The contactors are generally as described in the above numbered patent specifications except for the contactor buckets. Thus the contactor in each of Figs. 1 and 2 has a stationary drum 12 closed by end plates one of which is shown at 13, and a rotor 14 carried on a shaft 15 passing through the end plates 13. The rotor consists of a series of parallel, axially spaced, discs 16, the edges of which are spaced from the drum 12, and which define a number of compartments; in each such compartment buckets are carried between successive discs as shown.

In Fig. 1, the buckets are indicated at 17 and it will be seen that the leading edge 18 of each bucket does not project beyond the cylinder on which the edges of the discs 16 lie. The buckets in each compartment are circumferentially displaced from the corresponding buckets in the previous compartment, so that corresponding buckets in successive compartments are disposed in a helix about the rotor axis. The helix angle is chosen according to the nature of the solids to be treated and the process; for example, Fig. 1 shows eight buckets in each compartment, with $\frac{1}{2}$ pitch displacement from compartment to compartment.

In Figs. 2 and 3, the buckets, indicated at 20, are circumferentially displaced from compartment to compartment similarly to Fig. 1, but in addition the leading edge 21 of each bucket projects into the rotor-drum space so as to reach any layer of solids settled at the bottom of the drum. To avoid the solids scooped up by the projecting parts of the bucket being carried right up the contactor, the leading edge of each bucket has cut-outs 22 through which the solids fall as they are lifted.

CLAIMS

1. A slurry/liquid contactor comprising a drum through which the phases to be contacted pass; a rotor within the drum including a plurality of axially-spaced discs which divide the drum interior into a series of compartments and which have no central openings, the edges of the discs being spaced from the wall of the drum to form annular passages for the movement of the phases from compartment to compartment; and a plurality of receptacles mounted within a succession of the compartments to rotate with the rotor and designed to receive material of each phase and to shower it into the other phase as the rotor turns, the corresponding receptacles in the successive compartments being arranged helically about the rotor axis.

2. A contactor according to claim 1, in which the receptacles are arranged with their leading edges parallel to the axis of the rotor, and in which corresponding receptacles in successive compartments are displaced angularly from one another.

3. A contactor according to claim 1, in which the leading edge of each receptacle is formed as part of a helix, and the leading edges of receptacles in successive compartments form a continuous or near-continuous helix.

4. A contactor according to any one of the preceding claims in which the leading edges of the receptacles are disposed on or close to the cylinder on which the disc edges lie and the receptacles are secured between successive discs.

5. A contactor according to any one of the preceding claims, in which each of at least some of the receptacles has one or more slots

in it, opening to the leading edge of the bucket, to permit any solids captured by the leading edge of a receptacle at the bottom of the drum to fall through the slot or slots as the rotor turns and before those solids are lifted to any great extent.

6. A contactor according to any one of claims 1 to 3, in which the leading edge of each receptacle extends beyond the edges of the discs and has at least one slot cut into it to reduce the amount of solids raised by the leading edge.

7. A slurry/liquid contactor, substantially as herein described with reference to the accompanying drawings.

Printed for Her Majesty's Stationery Office
by Burgess & Son (Abingdon) Ltd.—1981.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.